

## WHAT IS CLAIMED IS:

1                   1.       A method for inspection of flat patterned media comprising:  
2                   detecting for defects of the flat patterned media through an imaging means  
3                   using a relatively lower resolution imaging and positioning protocol; while concurrently  
4                   reviewing, using imaging according to a relatively higher resolution imaging  
5                   and positioning protocol, defects which have been noted by said detecting step.

1                   2.       The method according to claim 1 wherein said reviewing step uses  
2                   dynamically-optimized on-the-fly, automatic focus imaging.

1                   3.       A method for detection of defects, concurrent with on-the-fly review  
2                   and classification of defect candidates in a flat patterned object under test comprising the  
3                   following parallel operations:

4                   acquiring images of the object; detecting defect candidates of said object; and  
5                   assigning review worthiness values to said defect candidates, through a defect detection sub-  
6                   system having a plurality of defect detection sub-system modules operative according to a  
7                   first relatively lower operating resolution; all while concurrently

8                   acquiring images of smaller areas around said defect candidates; reviewing  
9                   said smaller areas; and classifying said smaller areas, through a defect review sub-system  
10                  having a plurality of defect review sub-system modules operative according to a second  
11                  relatively higher resolution.

1                   4.       The method according to claim 3 comprising:  
2                   maximizing the number of higher priority defect candidates captured by said  
3                   defect review sub-system modules and minimizing distance traveled by said defect review  
4                   sub-system modules using a dynamic defect review sub-system module dispatching algorithm  
5                   for optimizing motion in said concurrent higher resolution reviewing.

1                   5.       The method according to claim 4 wherein said dispatching algorithm  
2                   further comprises:

3                   constructing, for each defect review sub-system and at each iteration of said  
4                   motion optimization, a forward feasible motion graph in a Graph Theory sense with nodes  
5                   corresponding to each defect candidate and current position of its associated module, and  
6                   with arcs corresponding to feasible motions in between said nodes;

7 associating costs for each said arc signifying a module movement from a first  
8 one of said defect candidates to a second one of said defect candidates, according to a  
9 suitable cost function selected from functions representing the cost of missing other defects,  
10 distance of required motion and review worthiness of a target defect candidate, and thereby  
11 obtaining a resulting graph;

12 solving the resulting graph for finding a minimum cost path, represented by an  
13 ordered sequence of defect to defect transitions, from the current location of the defect review  
14 sub-system module to the end of a window considered along scanning direction; and

15 computing motion data for the defect review sub-system module for  
16 controlling motion of the defect review sub-system module.

1 6. The method according to claim 3 comprising:  
2 beginning at a pre-determined distance from a target candidate location, and  
3 during the motion of the defect review sub-system module, automatically focusing the  
4 imaging element ;  
5 obtaining a focus quality metric curve using at least samples of a focus quality  
6 metric computed over the images;  
7 interpolating the samples of the focus quality metric curve with a smoothing  
8 function to determine a maximizing focus point for a z-stage used for moving the focusing  
9 optics; and  
10 directing the z-stage to a the z-axis position which maximizes the said focus  
11 quality metric curve to achieve sharpest focus of the target candidate location.

1 7. The method according to claim 6 wherein said focusing step includes:  
2 capturing a sequence of image data from an imaging element of the defect  
3 review sub-system; and wherein said obtaining step comprises  
4 using a sequence of image data in combination with said focus quality  
5 measure computed over the images to sample the focus quality curve.

1 8. The method according to claim 3 comprising:  
2 generating in the defect detection sub-system, a sequence of defect candidates;  
3 queuing and scheduling the sequence for imaging by a plurality of the defect  
4 review sub-system modules;

5                    dispatching the defect review sub-system modules to perform relatively higher  
6 resolution imaging of outstanding defect candidates to create a sequence of defect candidates  
7 associated with the relatively higher resolution image data;  
8                    causing the defect candidates to experience a two stage processing involving:  
9                    an automatic review process; and  
10                    an automatic classification process;  
11                    during the automatic review process, comparing the high resolution candidate  
12 image with a reference image stored in system memory of known defect status, wherein the  
13 comparing comprises compensating for known variations between test and reference  
14 including correcting for at least one of the following:  
15                    a) imaging instrument sensitivities, and  
16                    b) sensor pixel sensitivity variations;  
17                    compensating for spatial misalignment at sensor pixel level to result in either  
18 the validation of the existence of a legitimate defect at the candidate location or rejection of  
19 the defect as a false defect, including an artifact of known limitations of the low resolution  
20 DDS;  
21                    conveying information on legitimate defects to for automatic classification  
22 processing; thereafter  
23                    during automatic classification processing, using the relatively higher  
24 resolution defect image in combination with output of the automatic classification processing  
25 to extract relevant features of the defect; and  
26                    making a final decision on type of the defect through the classification  
27 processing.

1                    9.        An apparatus for flat patterned media inspection comprising:  
2                    a detection sub-system for detecting defect candidates through an imaging  
3 means using a relatively lower resolution imaging and positioning protocol; and  
4                    a review sub-system operative to concurrently review for defects noted by said  
5 detection sub-system using a relatively higher resolution imaging and positioning protocol.

1                    10.      The apparatus according to claim 9 wherein said detection sub-system  
2 is further operative to assign review worthiness values to said defect candidates.

1                    11.      An apparatus for defect detection, concurrent on-the-fly defect review  
2 and classification of phenomena in an object under test, said apparatus comprising:

3 a defect detection sub-system having a plurality of defect detection sub-system  
4 modules for acquiring images of the object, for detecting defect candidates and for assigning  
5 review worthiness values to said defect candidates according to a first relatively lower  
6 operating resolution; and

7 a defect review sub-system having a plurality of defect review sub-system  
8 modules operative to concurrently acquire images of a smaller area around the defect  
9 candidates, for reviewing said defect candidates and for classifying said defect candidates as  
10 defects using a relatively higher resolution.

1 12. The apparatus according to claim 11 wherein the defect detection sub-  
2 system is mounted on a first moveable gantry and the defect review sub-system is mounted  
3 on a second moveable gantry.

1 13. The apparatus according to claim 11 wherein the defect detection sub-  
2 system comprises a plurality of detection modules fixedly mounted on a first moveable  
3 gantry and the defect review sub-system comprises a plurality of defect review sub-system  
4 modules mounted for motion along on a second moveable gantry.

1 14. The apparatus according to claim 13 wherein motion of first ones of  
2 said review modules is limited by position of second ones of said review modules and further  
3 including a controller operative to:

4 construct a forward flow graph with nodes corresponding to defect candidates  
5 and current position of one of the defect review sub-system modules, and with arcs  
6 corresponding to feasible motions from the current position for the defect review sub-system  
7 module to first selected defect candidates and in between second selected defect candidates;

8 for each arc signifying a module move from one defect candidate to another  
9 defect candidate, associate costs to arcs as a function of cost factors, including a cost of  
10 missing other defects, distance of necessary motion, and worthiness of a captured defect to  
11 obtain a resulting graph;

12 solve the resulting graph for minimum cost path from the current location of  
13 the defect review sub-system module to an end of a y-axis window considered; and

14 compute motion data for the defect review sub-system module for controlling  
15 motion of the defect review sub-system module.